

MISSION

When she was a student, Pam Marcum '87, '89 M.S., could step onto her back porch and see the launches from Kennedy Space Center. Despite the Florida heat, the sight of a spacecraft heading skyward never failed to send shivers down her spine.

When NASA's exoplanet-finding mission, Kepler, rockets into orbit in February 2009, she's liable to get more than the shivers. As a program scientist at NASA Headquarters in Washington, D.C., Marcum has helped steer the \$600 million space-based telescope through miles of red tape and millions of dollars in potential budget cuts.

So will she do a victory dance? Whoop and holler? Cry? Terry Oswald, Ph.D., head of Florida Institute of Technology's department of physics and space sciences, doesn't think so. He has known Marcum since her first days as an undergraduate.

"Pamela is unflappable," he said.

But even the unflappable Marcum is excited by the idea that a project she's overseen for the past three years will soon be off the ground. "The most thrilling part of it all is that the data Kepler gathers could be the first baby steps toward discovering that we are not alone in the universe," she said. ▶

O R I E N T E D





Kepler is the space agency's first attempt to find Earth-size planets in the habitable zones (where there is liquid water that can support life) around distant stars. Using the technique of transit photometry, Kepler will monitor 150,000 stars for 3½ years.

The brainchild of William Borucki at NASA's Ames Research Center in California, the Kepler spacecraft (left) is outfitted with a .95-meter (37-inch) aperture Schmidt photometer with a 1.4-meter (55-inch) primary mirror.

As it orbits the sun, staring continuously at a portion of the sky in the constellation Cygnus, Kepler's array of 42 charge-coupled devices (CCDs) will register tiny fluctuations in light.

Each time a planet travels between Kepler and a planet's parent star in orbit, the planet will block some of the starlight. "A slight dimming of total light on a periodic basis, say once a year during Kepler's mission lifetime, would be a telltale sign of the presence of a terrestrial-size planet," said Marcum.

As if one weren't enough, Marcum is program scientist for yet another NASA telescope launching next year. Much different from Kepler, WISE (Wide-field Infrared Survey Explorer) is a \$300 million mission to map the whole sky at thermal (mid-infrared) wavelengths. "It's like looking out into space with a giant set of orbiting night vision goggles," said Marcum.

"WISE will take a census of stars in the local universe, looking for lukewarm, low mass stars near our own sun. We may discover that we have hundreds of stars right in our own backyard that we didn't know about before."

WISE could also see the most distant galaxies in the universe, the earliest galaxies formed, or an asteroid hurtling toward Earth. "There's a whole infrared sky out there full of surprises," said Edward L. (Ned) Wright, Ph.D., principal investigator for the mission. The survey will compile more than one million images during seven months of data collection, from which hundreds of millions of space objects will be catalogued.

That's enough data to keep astronomers busy for decades to come, including Marcum, who is passionate about her own research on galaxy evolution. When first considering the NASA post, Marcum knew she'd have to put that research largely on hold. She'd also need to request a leave of absence from Texas Christian University (TCU), where she has taught physics and astronomy since 1996.

She phoned Oswald for advice. "Terry was my first research mentor and is someone from whom I still seek counsel when I have important career decisions to make," Marcum said recently. Oswald, who spent two years as a National Science Foundation program scientist 10 years ago, recommended the move. "It's a career enriching experience to see the other side of proposals for research support. It's hard work but worth it. You have input on the creation of new programs and the next generation of funding."

Marcum, who completes her assignment at NASA this summer, agrees. Aside from the

Previous page: In her free time, Pam Marcum enjoys hiking. She is pictured at Bryce Canyon during a recent hiking vacation in the canyons of Arizona and Utah.

combined \$900 million budget for Kepler and WISE, she's responsible for another \$22 million in NASA's research and analysis programs, supporting detector development, laboratory astrophysics and suborbital payloads. She also organizes grant proposal peer-review committees, participates in federal multi-agency meetings and is actively engaged in national policy-making decisions impacting science research.

Science research was the main item on Marcum's agenda when she came back to Florida Tech last month. Oswald invited her to give a faculty workshop on grant-seeking. Having managed more than 150 NASA grants, Marcum knows the best practices for writing successful proposals and is glad to share them.

"NASA is one of the biggest grant-making institutions for astronomy; now Pamela's teaching us, rather than the other way around," said Oswald.

He adds that her visit coincides with the unveiling of the new research telescope at Florida Tech. Marcum seems to attract telescope activity wherever she goes. "In addition to earning her bachelor's degree in space sciences at Florida Tech, Pamela also earned two master's degrees, in space sciences and in physics. She was a pioneer here: she was our first observational astronomy master's student."

Marcum's research for the degree left its own legacy. Oswald recalls that she used a set of very old photographic spectra of white dwarfs at the beginning of her thesis project. This required Marcum to "make measurements of velocities and masses from microscopic shifts in the spectra on these plates." In order to make these measurements, she applied for and received competitively awarded time to use equipment at the National Observatories. The measurements she made and the new data she collected are still useful today."

Although Oswald thinks of Marcum now as a friend and colleague, he remembers her as a student.

"In class she was shy and polite. She was also very hard-working and inquisitive."

The shyness seems to have disappeared, but the other two traits are definitely hallmarks of Marcum's personality. The first in her family to go to college, she had a country girl's early love for the natural world. She still adds to the rock collection she began at three years old. When she was a young teen in a small town in eastern Kentucky, Marcum found a book in the public

library about stars. "I did a lot of reading about black holes; they really sucked me in," she laughs. But when she asked her high school counselor what an aspiring astronomer needed to study, the counselor didn't know. Marcum did her own investigating.

Marcum gained her doctoral degree in astronomy from the University of Wisconsin–Madison. She did postdoctoral work at the University of Virginia, where she collaborated with a team at NASA Goddard Space Flight Center on the shuttle-based ASTRO science missions, analyzing data taken with the Ultraviolet Imaging Telescope (UIT).

Her own research goes back to the excitement she felt when she read that first book on stars.

"It was a revelation to me that stars have a finite lifetime, that they go through life stages just like everything else." Now she studies the evolution of galaxies. She's

got a theory that refutes an idea accepted since the first supporting computational model in the early 1970s:

the notion that elliptical galaxies result from two or more spiral galaxies merging together.

The provocative results from the initial study—two of the galaxies appear to be free of any signs of a merged history—received press coverage. Her work convinced NASA to fund Marcum's lab in an expanded three-year study of this class of objects and to award competitive observing time on the ultraviolet satellite telescope, GALEX, for follow-up data.

"The unusual isolation of these galaxies greatly simplifies the possible explanations for their existence: they could be the product of a merger that occurred a very long time ago, or even more tantalizing, their existence may not have involved a merger at all," said Marcum.

If the galaxies were born as ellipticals, Marcum may be on the verge of an, ahem, astronomical discovery. But give her time. She'll be back at TCU to teach and continue her research this autumn. At the moment, she's juggling two telescopes for NASA.



Pam Marcum at Kitt Peak National Observatory; the tallest dome in the background is that of the 4-meter telescope.

Nancy Allison

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